Journal of the Society of Arts.

FRIDAY, MARCH 6, 1857.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 4, 1857.

The Thirteenth Ordinary Meeting of the One Hundred and Third Session was held on Wednesday, the 4th inst., John Hawkshaw, Esq., F.R.S., in the chair.

The following Candidates were balloted for, and duly elected members of the Society:—

Ford, Francis	Watney, Alfred
Ladd, William	Wright, Joseph, jun.

As a Corresponding Member.
Blancheton, Ernest.

The following Institutions have been taken into Union since the last announcement:—

432. Barnard Castle Mechanics' Institution and Literary Society.
433. Free Public Library, St. Margaret and St. John, Westminster.

The following Colonial Institution has been taken into Union since the last announcement:

Antigua Polytechnic Association.

The Paper read was:—

ON APPLIANCES FOR FACILITATING SUBMARINE ENGINEERING AND EXPLORATION.

By Major H. B. Sears.

Part I.—Submarine Engineering.

In the paper which I have prepared for the Society this evening, my purpose will be, not to enter into a dissertation on the various appliances which may heretofore have been used for facilitating subaqueous operations, pertaining to engineering science, but to confine myself more particularly to some of the advantages which experiment has proved may be derived from the use of machinery, constructed on a comparatively new plan, and embodying a more complete application of the natural principles which are the foundations on which rest all appliances for invading (personally,) the dominions of the Water King.

One of the great objects to be derived from our acquaintance with the arts, sciences, and manufactures, is to be enabled to devise means for advancing the progress of these various departments, by throwing new lights on the previously unknown or little understood details of different subjects, connected with each, or, by investigation, to discover new and more economical means of accomplishing the same results, either by a saving of time in the production, or of labour necessary for such production.

All science rests on the foundation of natural principles; and we gain largely, whenever, by a simplification of arrangement, we compel nature to perform man's labour. Water supplies us with steam to drive our ponderous engines which relieve us from arduous toil. It buoys upon its bosom the creations of man's hands, which transport from distant points articles necessary to his subsistence, or the gratification of his luxurious tastes. It is a necessary element. It is an element to be feared. It is full of dangers. It has its delights. It opposes us—it assists us.

In the subject now before you, it opposes obstacles, and renders necessary constructions to obviate its own difficulties; and yet, at the same time, lends a helping hand to assist greatly in conquering itself. You are required to restrain its power by opposing a barrier of rock; it receives the rock and buoys it up, relieving you of one-third of its weight. You desire to submerge a buoyant object; water will then reverse its power and cause it to sink. Being thus of a nature to oppose and yet assist us, and being governed by immutable and well-recognized laws, if those laws be properly enforced, or rather complied with, we may on the one hand restrain its dangerous efforts, and on the other, compel its assistance in ministering to our necessities.

The grand principle that air in an enclosed and inverted vessel, presenting a horizontal surface, will resist the entrance of water into that vessel, provided the air is of the same density as the water, is the principle which first determined the use of the ordinary diving-bell, an instrument now so often used in the preparation of foundations, and the subsequent erection of works under water.

In localities where the "coffer dam" is inadmissible, either through the cost or difficulty of construction, the ordinary suspended bell, pendant from a carriage at the surface, affords the necessary means for adjusting the work in such manner as the engineer may desire. It has been suggested, too, to use the ordinary submarine armour or dress for the adjustment in place of the stones of a work, which have been previously fitted at the surface.

In suggesting a new mode of operations, by which suspensory action may be entirely avoided, it would be impolitic to denounce the methods just mentioned, as being behind the age, since each would undoubtedly have its advocates, who from practical operations would acknowledge the advantages derived by its use, and perhaps look unfavourably on any innovation. No servant can be so humble, that, performing his duties well, though slowly, his services should not be recognized.

The Dover breakwater is an instance of the thorough efficiency of the ordinary bell, yet at the same time by its use the progress of the work has been necessarily slow.

The plan submitted in this paper for accomplishing, as it is confidently asserted, a larger amount of work in a given time, and at a less cost than by present means, is not a mere fancy, brought forward as a theory which cannot stand investigation and the application of practical knowledge to test its merits; but it is boldly placed before you, challenging the most rigid investigation of its qualities to secure the desired advantages of cheapness of construction and saving of time.

It would be a waste of time to engage your attention in speculation based on the mere working of models (exemplifications of principles), which, by the ingenuity of man, may be made to work with the utmost precision.

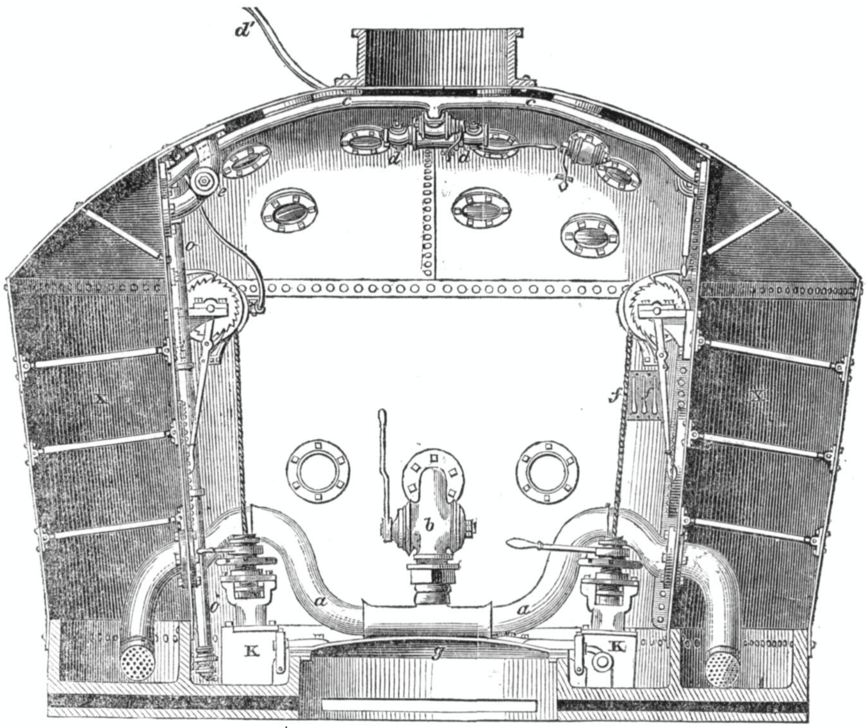
The principles involved in the machinery now presented to you, have all been thoroughly and practically tested; not in a single instance, but by months and years of careful investigation, going cautiously forward, taking the suggestions of nature as the guides to avoid the dangers and difficulties which are placed in the path of those who venture to step beyond the apparent bounds, which she herself has raised, to bar man's progress towards her mysteries.

Air and water, the two combined and powerful elements, are both difficult and dangerous to contend with. Water, by its gravity carries us downward; air, by its lightness or buoyancy, carries us upwards or keeps us at the surface; therefore it becomes necessary in any machinery independent of suspension, depending on the variable preponderance of one or the other of these elements, that these powers should be under perfect and complete control. The subtle nature of air requires careful management, and a perfect adaptation of parts to secure its control.

The Nautilus machine, which is presented to you as the instrument for overcoming many of the difficulties inherent to the nature of subaqueous operations, possesses among others the following qualities:—It is entirely independent of suspension; its movements are entirely dependent on the will of those within it, and without reference to those who may be stationed without; it possesses the power of lifting large weights, *per se*, and at the same time is perfectly safe, by common care, in its operations,—this latter the greatest desideratum of all. These advantages must, I think, strike all, as combining those requisites of success which have been always wanting in the present known means for constructing works under water.

The form of the machine is not arbitrary, but depends entirely on the nature of the work to be performed, adapting itself to the various circumstances attending any given position. By reference to the annexed diagram you

SECTIONAL VIEW OF THE NAUTILUS MACHINE.

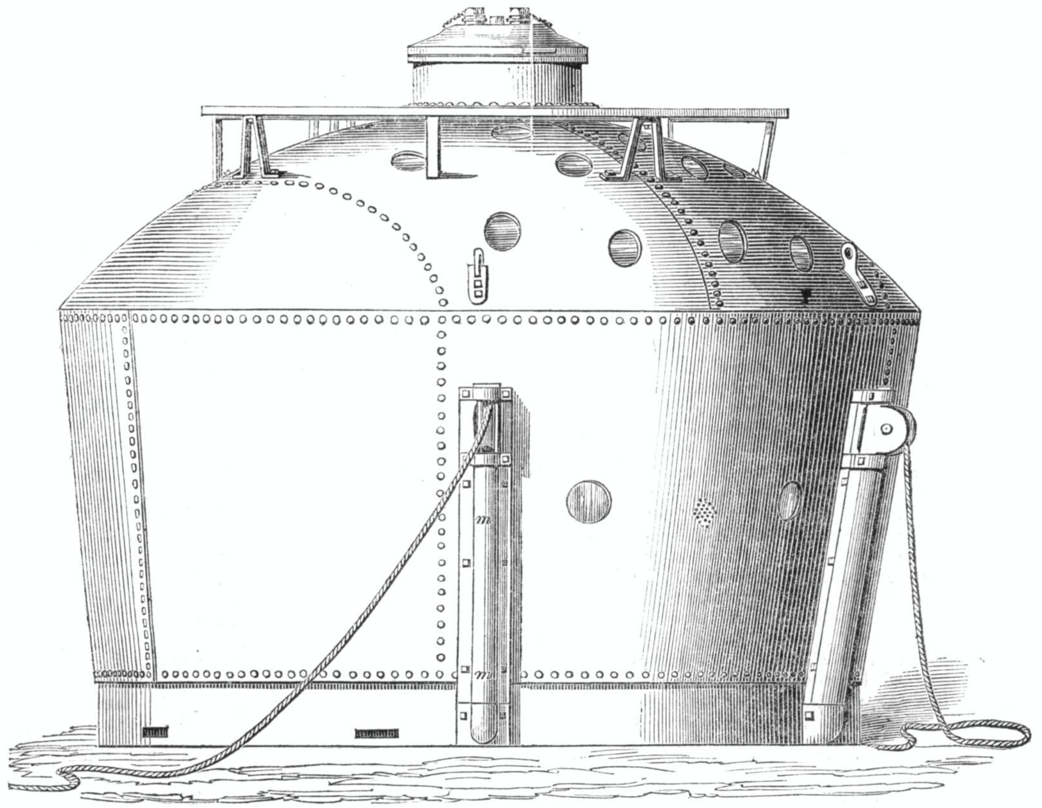


will perceive that when at rest, being entirely enclosed, its displacement of water being greater than its own weight, it must float at the surface. Entering through a man-hole at the top (which is closed either from the inside or outside), you descend into the interior of the machine, portions of which are walled off on either side, forming chambers; these chambers are connected at or near the bottom by a pipe *a,a,* which opens by a cock *b,* outwards to the external surrounding water. An opening in the bottom of the machine of variable dimensions is closed by a door or doors, susceptible of being opened or closed at pleasure. The chambers *X,X,* are likewise connected at top by a smaller pipe *c,c,* which opens through the top of the machine, and to which opening is affixed a flexible pipe, with coils of wire spirally enclosed. Branches on this latter pipe *d,d,* allow also communication with the larger or working chamber.

At the surface of the water, placed on a float or vessel for the purpose, is a receiver of variable dimensions, to which is attached at one end a hollow drum or reel to the barrel of which is affixed the other end of the flexible pipe *a,* leading to the top of the Nautilus. At the other end of, and in connection with the receiver is a powerful steam air-condensing pump. This combination represents the Nautilus machine as adapted to engineering work.

As to the *modus operandi.*—The operator, with his assistants, enters the machine through the top, which is then closed. To descend, the water-cock *b* is opened, and the external water flows into the chambers, *X,X*; at the same time a cock, *e,* on a pipe opening from the chambers outwards, is opened, in order that, the air escaping, an uninterrupted flow of water may take place into the chambers. The assumption of weight of water causes a destruction of buoyancy due to displacement by the mass itself, and the Nautilus gradually sinks. As soon as it is fairly under water, in order that the descent may be quiet and without shock, the water cock, *b,* is closed. The receiver at the surface, being previously charged by the air-pump to a density somewhat greater than that of the water at the depth proposed to attain, one of the branch cocks on the pipe, *c,c,* connecting the chambers at top, is opened, and the air rushes into the working chamber, gradually condensing until a density equal to the density of the water without is attained; this is indicated by proper air and water guages, *f,f.* These guages marking equal points, shewing the equilibrium of forces without and within, the covers to the bottom, *g,g,* are removed or raised, and communication is held with the bottom on which the Nautilus is resting. In order to move about in localities where tides or currents do not affect operations, it is only necessary to step out of the bottom of the Nautilus, and placing the hands against its side the operator may move it (by pushing,) in any direction. Where currents or tides, however, have sway, it becomes necessary to depend upon fixed points from which movements may be made in any direction. This is accomplished by placing in the bottom of the Nautilus stuffing boxes of peculiar construction, *k,k,* through which cables may pass over pulleys to the external side, thence

EXTERNAL VIEW OF THE NAUTILUS MACHINE.



up through tubes, (to prevent them from being worn,) to and over oscillating or swinging pulleys placed in the plane of the centre of gravity of the Nautilus, and thence to the points of affixment respectively. The object to be gained by having the swinging pulleys in the plane of the centre of gravity of the mass, is to hold the machine steady and to prevent oscillation. Within the machine, and directly over the above stuffing boxes, are windlasses for winding in the cables. By working these windlasses movement may be effected, and of course the number of these cables will depend on the variable character of the situation to be occupied. Having thus secured the means of descending, communicating with the bottom, and of movement, the next point is to ascend. Weight of water has caused a destruction of buoyancy at first, and consequent sinking; if then, any portion of this water is removed, an upward effort will at once be exerted, exactly proportionate to the weight of water thrown off. The air in the receiver at the surface being constantly maintained at a higher density than that of the water below, if we open the water-cock, *b*, and at the same time open the cock on the top pipe, *c,c*, throwing the condensed air from the receiver above directly on to the surface of the water in the chambers, movement and consequent expulsion of the water must take place, and an upward movement of the machine itself, which will rise to the surface.

It is evident that if, previously to the expulsion of the water, the Nautilus be affixed to any object below, the power exerted on that object will be exactly proportionate to the weight of water expelled, and the power will continue increasing, until there being no further weight to be thrown off, the maximum effect is produced. To apply this power to lifting masses of stone or rock, proper arrangements are affixed to the centre of the opening in the bottom, by which connection can be made with the weight, admitting at the same time the swinging around of the object suspended, so that it may be placed in any required position. In the construction of permanent works, or the movement of objects whose weight is known, or can be estimated, a water or so-called lifting tube is placed on the side of the water chamber which indicates the lifting power exercised by the Nautilus at any moment. The advantage of this guage will be recognised, inasmuch as (without it) the closest attention of the operator working very cautiously, would be necessary to determine when the weight was overcome; by its aid however, the operator boldly throws open all the valves necessary to develop the power of the Nautilus, watching only the guage. The water having reached the proper level indicating the required lifting power, he knows the weight must be overcome or so nearly so, that the valve or the cocks may be at once closed, in order that the movement may take place horizontally. A moment's reflection will show, that if there were not an index of this character, carelessness or inattention on the part of the operator, by leaving the cocks open too long, might develop a power greater than required, and the Nautilus would start suddenly upward. The expansive power of air, acting upon the incompressible fluid water, through the opening in the bottom, gives a momentum, which by successive developments of expansion in the working chamber, is constantly increasing the velocity of the Nautilus upwards, until in any considerable depth of water, the result would be undoubtedly of a very serious character. Take for exemplification the Nautilus in 33 feet of water, the bottom covers removed, and an equilibrium at 15 pounds to the inch existing between the air and the water at the level of the bottom of the machine. Upward movement is communicated the instant the machine rises in the slightest degree, the existing equilibrium is destroyed, and the highly elastic qualities of air assume preponderance, exerting from the rigid surface of water below, an impulsive effort upward in the direc-

tion of least resistance. At each successive moment of upward movement, the impelling power increases, owing to the increased disparity between the pressure of air within struggling for escape, and the water without preventing that escape. The machine thus situated becomes a marine rocket (in reality), in which the propelling power is exhausted only when the surface is reached, and a new equilibrium is obtained. It will readily be seen, that were this difficulty not overcome, it would be impossible to govern the Nautilus; for, rising with great velocity to the surface, the machine is carried above its ordinary floatation or water-line; a little more air escapes owing to the diminished resistance, as that level is passed; the recoil, or surging downwards, causes a condensation of the air remaining in the chamber; a portion of the space previously occupied by air is assumed by water, the buoyant power becomes less, the machine settles slightly more by condensation of the air, a larger space is occupied by water, and the Nautilus redescends to the bottom with a constantly accelerating movement, seriously inconveniencing the operators by filling more or less with water according to the depth. For many months the difficulties just enumerated baffled all attempts at control. A weight attached could be lifted, but the instant it was entirely suspended, before the valves could be closed, upward movement was communicated entirely beyond control. This difficulty so fatal, has been overcome by an arrangement of the bottom of the Nautilus, with channels which radiate from the opening in an inclined direction, debouching at the sides of the machine. The moment then, that the air, by its expansion from diminished resistance, or by the introduction from above of a greater volume than can be sustained by the water below, reaches in its downward passage, the level of these chambers, following the direction of least resistance, it passes through these channels and escapes into the surrounding water, without of course affecting the movement of the machine in the least.

I have thus, I trust, shown to you the principles on which the engineering facilities of the nautilus depend.

First, on natural principles, from construction, it must be independent of suspension; and here allow me to bring forcibly to your minds the distinction between a machine which, by its own power, may descend, ascend, move horizontally, lift weights, and transport them by itself (for I assume the operator to be a part of the machine), and the ordinary diving-bell so long used, by which we are enabled to perform the same operations, after much time spent in the preparation of piling, platforms, scaffolding, carriage-way, &c.; and where all necessary movements in the prosecution of the work must be made at the surface through the intervention of signals, which in all cases must be more or less liable to error and misunderstanding.

Supposing the same skilled and careful men to be placed under both conditions, the one time in the ordinary diving-bell, where, when they have determined on the necessary movements to be made, they signal to the surface, and await, first the proper under-understanding of their wishes, and then subsequently, their execution by those who cannot know precisely the amount of assistance required; or another time, in a machine possessing the capabilities heretofore enumerated, by which the operator, having his work directly before him, watching all the varying circumstances which await his progress, foresees and applies directly his own hand to the work, governing and directing in person those operations which he requires to be performed—certainly the balance must be all in favour of the latter position.

Another thing in the case of the ordinary diving-bell, much time is necessarily consumed in making the necessary preperations to commence the use of the machine; in the other case, when once arrived at the spot required (if in the water), it is ready for immediate service, either to examine the bottom previous to the location, or to commence the foundations at once.

To speak now of that portion of the machinery which remains at the surface:—It is necessary in order to rapid movement, that the supply of air which, acting on the water in the water-chambers, causes the development of the lifting power of the machine, should be in sufficient quantity, so that no delay may arise and that a constant supply may be continually afforded, that there may be no diminution of density in the receiver. It is also necessary that the density of the air in the receiver should at all times be greater than that of the water at the depth to which the machine descends, so that the superior pressure of the air may produce instantaneous movement of the water. A proper proportion of density in a receiver would be about one-third greater than that of the water.

The amount of air continually required for the respiratory purposes of the operators, and also for the purpose of lifting weights, demands a large supply, which is obtained from the steam-condensing pump directly to the receiver. The air-pumps are constructed to throw any required amount of air, each sufficient if required, to work two or three, or even more machines engaged in lifting heavy weights.

There is no heating, owing to the rapid condensation of air at high density. The pumps will work continuously at the highest density, without any perceptible increase of temperature. The economy of working several machines from the same or different receivers, supplied by one pump, is great, as the saving of labour, fuel, wear and tear, in one engine over several, is quite apparent; which economy is due in part to the independence of suspension, allowing the receiver to be placed at any convenient point, even quite distant from the "Nautilus," inasmuch as the pipe may be supported on the surface of the water to the point over the work itself.

Having the powers of air and water then at control, to obviate the use of platforms, trucks, and carriage-way, to lower stones into place, so that they may be properly deposited, you may readily see that a caisson or float, properly arranged with regard to the relative centres of gravity and buoyancy may be moved over or near the work. A load of stone, according to the capacity of the caisson, may be placed upon it. Having this caisson so arranged by divison into chambers, that the water cannot flow from side to side, and constructed with water valves and a connection with the receiver, when the load is properly placed upon it, and the water-valves opened, it will commence to sink. Regulating its descent slowly by the same process as the Nautilus itself, but governed from above, it may be placed in proper position, so that the least possible distance will be required to be passed over, in removing the stones so lowered to their ultimate position of permanency. As the weights are removed, it is obvious that more water will be required to be admitted, in order to retain the caisson at the bottom or on the work. The whole load being removed, to return to the surface, it will be merely necessary to throw from the receiver at the surface a portion of condensed air, to cause it to rise preparatory to its receiving a new load.

The comparative cost of lowering away stone in this manner, as contrasted with the ordinary crane, can hardly be doubted as being favourable to the first method, inasmuch as water is valueless, and the supply of air required to expel that water, as delivered from the condensing pump, can bear but a slight ratio of cost to the labour required to work the cranes. The cost of working a steam-condensing pump sufficient to lower as many stones as would supply two machines, as well as working the machines themselves, would not be more than thirty shillings per diem.

Where water transportation of material is afforded, the caissons themselves may be used as the means of

transportation of the stone from the quarry to the site of the work; and then fulfilling their real purpose, of depositing their load in the bottom. A great facility afforded by this process is, that there must always be a supply of material below, in advance of the requirements of the adjusting machines, so that no delay can arise by waiting for materials.

For removal of rocks: the facility that is afforded by going down directly on the bed of the rock, there drilling a series of holes, subsequently charging them, and then exploding them connectedly, would seem to be almost equal to that of the quarry. If large masses be detached, camels inflated, or charged from the receivers may be affixed to them (if too large for the nautilus itself,) and when lifted, towed to the place of deposit, and there left.

Manual labour alone can now be used below water; for steam, our great substitute, cannot be passed through so great a length of hose, and through varying temperature, as is necessary, without condensation; but air does not change its density by passing through great distances, or by any moderate change of temperature.

Having a supply of air at the necessary density for a motive power, it may then be used as such, to propel the necessary drills for boring rocks, by having the proper engines placed within the "Nautilus," and exhausting to the surface. Air being at the same density as steam, and contained within the receivers, which are atmospheric boilers, we may apply the powers of air below, the same as steam at the surface, to the performance of any labour which may be required. There is no difference between air and steam at the same density in their application, except that in the use of air, which is a more subtle fluid than steam, we must exercise additional care in the arrangement of valves, &c. The powers of air which can be developed at the surface in any required amount, are not only applicable to the working of drills for boring rock, but for the sawing off of piles in the preparation of foundations, and for any other purpose where the application of manual labour at comparatively high cost, should if possible, be obviated.

To saw off piles for foundations. If one pile be driven or cut off at the requisite level, the Nautilus, which by construction retains its lower surface in a horizontal position, resting on that pile, and working a saw in the plane of that lower horizontal surface, will of necessity, cut all the piles with which it may be brought in contact in the same plane, then preparing the grillage and planking necessary, when lowered, the Nautilus passing over it can cause it to be securely affixed to the heads of the piles so cut off.

It is manifest that, unless very carefully arranged, any submerged vessel descending rapidly, and striking on any projecting object, would be liable to be thrown from its horizontal position, and to be overturned. Assume that the ordinary bell is descending, and strikes on a projecting or shelving rock, lowering away from the surface; unless the signals are distinctly understood, the chances would be very great of an overturn, resulting in great danger to those within.

In the case where no suspension exists, it becomes necessary to overcome any such tendency to danger, which is done by so harmonizing the centres of buoyancy and of gravity, that under no circumstances can there be but a very slight deflection from a horizontal position. Gravity acts downwards and buoyancy upwards, both in vertical lines. Construct a machine symmetrically, then, with the centres of gravity and buoyancy in the same vertical line, the one near the bottom, on account of weight, the other by peculiarity of construction, as far removed as possible from the first, or as near the top as may be. If, by any means the horizontal position should be destroyed, both forces at once act to restore its original or correct state, gravity downwards, buoyancy upwards; and the power or effective lever which tends to restore it to this horizontal state, will depend on the distance apart of these two centres; therefore I may say, in a properly constructed machine an overturn could never be experienced.

This is a very important subject to be considered, for as there is no chain or rope to cause return to the surface, unless this point were thoroughly guarded there would be no safety at all, since if the Nautilus once received an inclination by the escape of air from the upper side and entrance of water on the lower side, the movement would increase until the whole might be overturned.

It would be unadvisable to say that any given amount of work could be performed by the Nautilus machine in a given time under all circumstances. The power of the machine is positive, and can be certainly relied on; but it may not always be possible to exert that power to its full extent. The length of time required to submerge a first-class machine, lifting six tons, will be two and one-half minutes. Going down slowly, sixty feet per minute may be attained. While the machine is descending, the working chamber may be filled with air of the proper density to resist the entrance of water when the bottom cover is removed. Two minutes are sufficient to unclamp and raise the covers. If the object to be raised be immediately beneath, as soon as the necessary connections can be made, the water cocks are opened and the air is thrown into the water chambers, which can be entirely emptied giving its full lifting capacity of six tons in one-and-a-half minutes.

As to movement horizontally.—Every practical mind can form its own conclusions, as to the rapidity with which such a buoyant mass could be moved through the water. An extract from the report of Mr. Gay, Chief Engineer, U. S. Navy, to the Bureau of Docks and Yards will verify the statements I have made :—

* * * "With the assistance of two experienced persons, I descended in the bell to about twenty feet below the surface of the water. The time occupied to *prepare the bell* and reach the bottom was about *two minutes and thirty seconds*, and about a minute and-a-half to return to the surface. * * *

"One of several blocks of granite, weighing about four tons each, had been previously prepared, and placed on the bottom; the bell was attached to this stone by a 'Lewis.' * * * The time occupied in securing the stone and coming up was about three minutes. * * * I descended with the stone, and, by the aid of two men, transported it several feet laterally, with as much ease as it could have been done were it suspended upon a crane, with the advantage of placing it at any point, or in any desired position."

By skilful and practised manipulation, the powers of any machinery must be developed in a greater degree than by unskilful handling. In acquiring the necessary skill, the necessary length of time required depends much on the complication of the principles involved, or the details by which the results are obtained. In working the Nautilus machine, it is not necessary that the operator should be a scientific man or practical mechanic. By the absolute control of natural elements, the will of the operator as it were, directs and governs the movements of the machine. It is thus the operations of the machine are comparatively inexpensive, since you are required to pay for labour alone, and not to compensate for the genius to comprehend or the skill to control a complicated and delicate instrument.

In any paper description of a new system, of whatever nature it may be, it is impossible to enter into sufficient detail to enable the mind at a single glance, or by a single hearing, to fully comprehend all or even most of the advantages claimed, or of the disadvantages which may be found apparent. In the case however of the system which I have the honour of presenting to you, as applied to submarine engineering, based as it is on purely natural principles, whose partial application heretofore has been attended with a degree of success, certainly of a satisfactory character, the principles laid down I trust, are

so easily understood that no one can fail to admit that, certainly *if* the principles in their adaptation in the Nautilus, are governed as represented, the value of the improvements thus made must be of great practical importance to the engineer, by rendering his labours free from much anxiety, and enabling him with confidence to undertake works of peculiar characteristics of position, which, previously considered, would have seemed hazardous.

I cannot flatter myself that in this system, a sovereign panacea has been discovered for all the dangerous symptoms which the engineer meets with in the practice of his profession under water; but I trust that you will admit, that certainly his toils may be rendered lighter, his risks diminished, his expenditures curtailed, his time saved by this process.

A sketch of the construction of a work, by present process, and by the use of the Nautilus may be permitted me. We will suppose the location selected, and that the impracticability of constructing a coffer dam has rendered necessary the use of the ordinary diving bell, which we will also suppose, is already constructed and ready for use. The first step will be to commence driving the piles upon which the scaffolding is to rest; the scaffolding must then be constructed; the rails must be laid for the passage of the suspending trucks; these trucks must then be placed in position and prepared for use. The bell is then suspended, and we will suppose is ready for work, a considerable amount of time having been expended in this preparation. The bell is raised out of the water, the masons enter, and are lowered away. The descent must be slow, for the weight is great, the chains are stiff, and manual labour is required to overcome these difficulties. Then too, being open at the bottom, lowering away can be effected only as fast as air is supplied by the pumps from above to resist the encroachment of water. The bottom is reached and work is commenced. Movement is necessary—signals are made by blows on the side of the bell, or by the signal cord—at the same time the signal is made and understood at the surface, they commence to move the whole apparatus as directed; the truck at the surface and the bell below move together. It is desired to stop; before doing so, new signals are necessary, movements below being restricted in their efficiency by the proper understanding of signals. You wish to move slightly only, you are carried too far and must return.

In the preparation of foundations where in many cases it is required to move often from point to point in excavating or levelling, this delay becomes important. The foundations, however, are prepared, and the superstructure is commenced. A stone is lowered. The bell by signal is moved over it, and they are connected;—signal to the surface, and the weight of the bell and the stone must be raised together;—signal again to stop hoisting;—signal to move in or out, right or left;—movement is made;—the spot is reached, and the stone must be deposited precisely. The mason says—a little to the right, but he cannot say how many inches and he gets too far; then by successive movements by signal he is accurately placed and lowered away. Then to place another stone he goes through the same process. Mark the time consumed here from want of independence. He sees the stone; he knows it must go there, in that spot, but he cannot himself exercise the power necessary to place it there, but must wait the pleasure and understanding of his directions by others, who of course can only have a general idea of his wishes.

In this way the work is carried on. Other difficulties are however, in the way. The bell suspended below is a pendulum of variable length; if the water be rough at the surface, a swaying or oscillating movement is given to the pendulum, which, in its oscillation however slight, disturbs the horizontal equilibrium between the air and the water, and the air escapes from the upper side, and water enters on the lower side. The pump must then be signalled to work, to restore the volume of air and drive back the water. Oscillation too is dangerous, if at all of a serious character, for the masons may be injured in their limbs if standing on the bottom with the bell suspended. The mason knows too, that if the chain, on which rests his entire hope of safety should break, that the chances are almost certain that his life is lost (numerous instances have attested this latter point); the weight is too great for him to attempt to raise it, and his workshop furnishes him with a metallic coffin. It is evident that no man, however daring he may be, can work with so much will where the chances of danger, however remote, are independent of his own power of governance, as he can where he feels that his own will can at any moment remove him from the possibility of danger.

In reascending to the surface after the completion of duty below, the movement must necessarily be very slow, owing to the same reasons previously enumerated in lowering away. If the chain break while ascending, where would be the labourer's chance?

Enough of the difficulties below. There are still dangers and difficulties at the surface. A storm arises—the work is in an exposed situation—and a portion is weakened, perhaps carried away.

The necessary time must be taken to strengthen or reconstruct the damaged portions. This involves time, it involves expense.

We will now suppose a position, as the removal of a rock, or the construction of a pier-foundation, &c., where it is impracticable to construct platforms and stagings. A boat from which to suspend a bell must be used. Any motion communicated to this boat at the surface, must cause the oscillation below which I have previously spoken of as greatly retarding or entirely putting a stop to operations while such motion is experienced.

Take now the location where the coffer dam is adopted. The first step is to construct the dam, which is a work of time, which is an expense. The dam however being completed and free from leakage, of course the work can then be carried on with great rapidity; but there are difficulties even here; springs in some cases cause difficulties; leaks too, arise. A storm, by weakening a portion of the dam, may cause a delay for repairs or even may demand an entire reconstruction. Of course to the mind of everyone present this is but a suggestion of some of the difficulties which in all cases, in a greater or less degree, attend the construction of this class of works. There is no need of bringing them forward except to place them in contrast with any means which may mitigate their action in whole or in part.

To contrast the action of the Nautilus and to see how far by its action, as previously described, these difficulties may be overcome, I will suppose as in the case of the ordinary bell, the location is decided on. And first, before a decision upon that point is arrived at, you will undoubtedly recognize the facility which the engineer possesses by its use in descending himself, and by accurate survey determining the most favourable position for such location. The nature of the foundation required being determined, its preparation may be at once commenced, since, towing the Nautilus to the spot, your workmen are ready at once to commence work at the same time that, in the other case, they commence the driving piles for the scaffolding. While the scaffolds are being erected, it is but fair to suppose that great progress may have been made by the Nautilus in the construction of the work itself. I have previously shown that, being in position, but a very few moments are required for the workmen to reach the bottom. They then see their work and are ready to prosecute it. No signals for movement are necessary; they wish to move an inch, a foot, a rod, it is done at once; there is no restraining influence, which is not subject to their own will. When their labours are ended they themselves return to the surface, as rapidly or as slowly as they please.

The foundations being prepared to carry on the superstructure, the stones necessary are lowered down by any means, either by cranes or boats for the purpose, or by the caisson method previously described. They will be deposited in a given position and lowered in the order in which they will be required in the work. The chief mason or operator then, knowing the precise position of deposit, which, of course, will be as near the ultimate position of permanency as possible, will so arrange his facilities of movement as to pass in a direct line to and from what may be styled his quarry or place of delivery. He affixes to stone No. 1, and by the power of his machine he suspends it, then moves it, and deposits it. Is it not evident that with the great power of lifting in so rapid a manner, and the movement dependent on his own will, and the subsequent slight movement of adjustment in position, that the whole operation could be performed in very nearly the same time that the truck suspending the ordinary bell, moving by signals, could be placed over the stone ready for lifting? The stone being placed, the nautilus returns to the quarry for No. 2. No delay is experienced, but the action is immediately performed, since all thought necessary is previously exercised. No. 2 follows No. 1, No. 3 No. 2, and so on; the exact measure of juxtaposition having been laid down before the machine is called into requisition, and the memorandum of such detail being in hand. So long as the quarry is supplied, as fast as the various powers of the machine can be called into play the operations must continue uninterrupted.

The mason or workman feels no sensation of danger. If his single connection with the surface which supplies his power, be ruptured, he returns to the surface to make a reconnection. He is restrained for the time being, from exercising any lifting power, but his safety is unimpaired. If a stone break loose its connection, he goes to the surface and there remains until he chooses to descend to make a reconnection. So long as his supply of air is uninterrupted, he cares not for the surface or what is going on there; cut off his supply of air, he knows it and takes his own measures and precaution. While the surface of the water is agitated, unless near the surface, it does not interfere with his operations, since there being no suspension and a sufficient quantity of pipe submerged, or anchored below the surface, no action of the water can impede his movements, as there is no oscillation. The attending floats may be tossed at the pleasure of the waves, so long as they can ride at their anchors or mooring blocks. Should, however, the water become too rough to operate, the Nautilus returns to the surface, and being confined by its anchors, and being a life-boat in itself, no damage can arise by leaving it in position; or the whole afterwards may be towed to a position of safety, and there await the cessation of the preventing cause of operations. The moment those causes have been removed, operations may be resumed at once, since no part of the apparatus or fixtures has been exposed to deterioration or loss.

The same number of men would be required on the Nautilus as in the ordinary bell, at the same prices for labour. The attendant labourers at the surface required in the movement and suspending the ordinary bell would be dispensed with, consequently the cost of producing the same amount of work would be less in the case of the Nautilus. But I trust that the facilities herein demonstrated have shown that the self-acting powers of the Nautilus, directly at the control of the operator, afford the facilities for performing a greater amount of work in a given time than by ordinary means, and as the amount of labour is less, there must be a saving of both time and money. There are other means, such as caissons for constructing portions of masonry which are subsequently placed in positions, upon which I need not expatiate. Their use is confined to particular localities, and they are not susceptible of general application in the construction of submarine works.

In this paper my purpose has been, not to make invidious distinctions between the ordinary diving-bell now in use and the Nautilus, which occupies so prominent a position herein, but to bring forward the merits and defects of the whole system, and place them in contrast with the machinery which has developed powers, which, in the opinion of competent scientific minds, overcome many of the difficulties as well as dangers, which have heretofore enveloped the science of submarine engineering.

DISCUSSION.

Sir John Rennie, F.R.S., in a letter to the Secretary, says:—"I am much obliged to you for a copy of Major Sears's intended paper to-morrow on the "Nautilus Diving Machine," and am sorry that I cannot attend. The diving-bell was first endeavoured to be adapted for engineering operations by Smeaton, at Ramsgate-harbour, in 1788, but he could make very little of it, and, in fact, never used it for building. In 1812 and 1813, my father entirely remodelled the system, and made many improvements, so that he completely rebuilt the East Pier of Ramsgate-harbour outer head in 16 feet at low water, and subsequently employed it at Holyhead, Howth, Kingston, Sheerness, Plymouth Harbours, and other places for the same purpose, and I have done the same, and it is difficult to find a machine which answers its purpose more completely. Diving dresses by Bethell, Dean, Siebe, and others, have been used with great advantage in examining vessels and various other works, and I believe for building at Weymouth and elsewhere, but I do not like them so well as my father's diving-bell and apparatus, detailed plates of which you will find in my works on the Breakwater in Plymouth Sound, and upon British and Foreign harbours.

"As to the Nautilus machine, if I understand rightly, it resembles a good deal an invention claimed as American, also by Fulton, called a submarine diver, which was employed in the late war, 1809-10, for attaching torpedoes to our ships of war, and thus blowing them up at their moorings. It answered tolerably well for a time, but at last the diver in it got confused and was drowned. He could move under water like a fish, and raise and lower the machine by simply letting in water and forcing it out again by condensed air.

"The diving-bell can be used from a floating-stage or vessel very well, and I built Port Patrick Pier-head in 21 feet at low water with it in this manner, in 1827. As for cutting off piles under water, we can do it better by a circular-saw, worked from above, as we did at Sheerness. I hope that you will not consider that I have attempted to depreciate Major Sears's invention, which may be very ingenious, and I wish it every success, but in all discussions we ought to know what has been done before."

Sir CHARLES FOX said he was sorry he was not aware of the nature of this machine before attending this meeting; otherwise he believed he could have stated a few facts of interest upon this subject. This was another instance in which several ingenious minds had been at work upon the same idea. About two years ago Herr Bauer, a Prussian gentleman, brought under his notice a machine somewhat resembling this in construction; but, as it was defective in some of its details it could not be brought into practical operation, and he so reported to the inventor. About the same time, information reached him that there was a machine at work removing rocks from Cherbourg harbour, the invention of Dr. Payerne, which appeared to contain all the essential points of the Nautilus. This was described to him at the time as a machine in which fourteen men could walk away from the shore under water for half a mile or more, and remove a quantity of rock, remaining without communication with the shore or the surface for twelve hours, and returning to the shore without difficulty or inconvenience. He felt the matter to be so important,

that he directed his assistant, Mr. Cochrane, to go to Cherbourg and inspect the operations. He did so, and furnished an elaborate report upon the subject. From this report (he Sir C. Fox), believed there would be no difficulty in constructing a submarine vessel so as to form a most powerful engine for the destruction of the ships of an enemy. An order was immediately given to him by the Government for the construction of such a vessel, which was executed by Mr. John Scott Russell; the termination of the late war, however, prevented the full testing of the terrible powers of that machine, but that it would accomplish all the objects contemplated, experiments made with the apparatus had abundantly proved.

Mr. Frederick Lawrence believed this invention was not even so modern as had been stated by Sir Charles Fox, for he found that in 1776 a premium of 20 guineas was given by this Society to a Mr. Spalding, of Edinburgh, for his invention of a diving-bell,* which appeared to possess the main principles of the apparatus now before them. It had two chambers, an upper chamber to contain air, and the other a working chamber, similar to the design of Major Sears. By the introduction of air into the upper chamber, the bell was raised to the surface, and admitting the water in the place of the air, the bell sank again to the bottom. He thought that was similar in principle to the apparatus of Major Sears. He was not aware whether the machine to which he alluded had ever been brought into practical operation. He believed it was no part of the design of the inventor to do away with the chain at the top, which he (Mr. Lawrence) could not but regard as a double measure of precaution in the use of such machines. Major Sears appeared to think that connection with the surface by chains was dangerous; but he must be aware that in submarine operations it was not customary to trust the machine to one chain only, but a safety chain was attached, together with the hose for supplying air to the machine, and in the event of any casualty occurring to the chains, he apprehended the machine would be supplied with sufficient air to afford time for the attaching of another chain to the diving-bell. He thought in Major Sears's invention the great danger would be from the hose breaking, a case very likely to occur in a strong tideway, if a guy-rope should break; and that once broken, it appeared to him that the raising power of the machine was destroyed, and it would then become in reality a metal coffin to the unfortunate persons within it.

Mr. Heinke remarked that his experience related to diving dresses rather than to the diving bell itself, and he believed that the diving apparatus had been brought to such a state of perfection that by its aid they could accomplish everything for which the diving bell was designed. One great objection to the apparatus of Major Sears, as far as he could see at present, was its cost, which was a consideration in engineering matters. By means of the recent improvements in diving dresses, a diver could sink or raise himself with the greatest ease by means of valves attached to the helmet, which were perfectly under his control. At the works at Westminster-bridge, a diver met with the accident of breaking the glass of his helmet whilst under water, by striking it against a large spike in one of the piles. He was nearly stunned by the blow, but having the presence of mind to close the valve in front of the helmet, the result followed, as in the case of Major Sears' apparatus—the diver came to the surface. The fracture of the glass operated in the ame manner as the opening of a valve. On another occasion, at the same work, it was found that one of the stones of the foundation had not been properly laid on its bed, owing to a quantity of dirt getting beneath it. This was about 11 o'clock at night. By signal from the diver the stone was raised a few inches, so that he could introduce his arm, and having cleared away the dirt, the stone was again lowered into its position. He believed that two or three men furnished with diving dresses could do the same work as was accomplished by means of the diving bell.

Mr. Fraser expressed a wish to be informed as to the different dimensions of which this apparatus could be constructed. In a work on which he was at present engaged, viz., removing a bed of concrete in a well at a depth of 90 feet under water, such an apparatus would, no doubt, be of great service, as also in the sinking of wells generally, if it could be made of dimensions sufficiently small for the purpose. With regard to diving dresses, he questioned whether anything had yet been invented in that way which would enable a diver to remove with facility a weight of six tons, which could be effected by Major Sears' apparatus.

Mr. John Bethell said his experience had been more with diving-dresses than with diving-bells, but he thought a mistake had been committed in the construction of the old diving-bell. They used to be made very heavy, and were still made of great weight. In his opinion it was unnecessary to construct diving bells of such great weight or strength; all the weight necessary was simply that which was sufficient to sink the machine in the water; they had merely to weight the bell in proportion to the displacement; but with regard to the bell itself, it was unnecessary that it should be of a thick material. Twenty-five years ago he showed that a diving-bell could be made of india-rubber cloth stretched over an iron frame, and it would be just as sound and effective as a bell of cast iron, five inches thick, because the bell had an internal pressure of condensed air to counteract the external presure of the water upon it—the two pressures balancing each other. He also showed, five-and-twenty years ago, that a diving bell might be made of thin sheet iron; and in order to enable the divers to move it when they pleased, there was placed at the top an india-rubber bag, like an air-cushion, which communicated by a pipe with the top of the bell. By the diver turning a cock inside, and allowing a portion of the air to pass into that bag, he caused the bell to rise, and by pulling a string attached to a valve in the top of the cushion the air was let out and the bell sank. Consequently one or two men in the bell, by working the cock, could so regulate the gravity of the machine that they could conduct it to any place they pleased, and then allowing the surplus air from the bag to escape, the bell descended to the required spot. One of the most simple, and at the same time most profitable diving-bells ever worked, was that employed in recovering property from the wreck of the *Thetis* frigate. That bell consisted merely of a ship's iron tank. A hole was knocked in the bottom of the tank, which was weighted with a few pigs of ballast. The fire-engine pumps were employed as air pumps, and there was the diving-bell all ready for use. By that means property to the value of £500,000 was recovered from the *Thetis* frigate. With regard to the apparatus now before them he would remark that it was very ingenious, but exceedingly complicated. The mode of making a diving-bell was very simple indeed. A bell capable of holding six divers could be made for a small sum, and by attaching the air bag in the way he mentioned it could be moved about with facility. Twenty years ago he sent out closed diving dresses; the air was supplied to the helmet by an air pump, and the foul air was driven off through an open pipe leading from the top of the inside of the helmet down to, and discharging its air into, the water just above the diver's right shoulder. The diver had merely to apply his finger to close this pipe, and he came up immediately, and on taking away his finger he sunk again. By these means he could raise himself to any height in the water and to any spot desired, or on to the sides of rocks on which he might have to operate. These dresses had not only been used in Europe, but in many other parts of the world. Two of her Majesty's ships were saved by the use of these

* Transactions of Society of Arts, Vol. 1, p. 220.

dresses. The *Wellesley*, 120 guns, on entering the harbour of Ceylon, in 1838, struck upon the rocks, and would have foundered, but the diving apparatus was rigged out, and in twenty minutes the carpenters repaired the ship thoroughly. The other ship, the *Thunder*, ran upon rocks off the Bahamas, in 1837, and sprang a leak. It was ascertained that there was a diving apparatus at Nassau, belonging to Dr. Lee, who lent his dress to Capt. Owen, and after the damage had been surveyed by the captain and first-lieutenant, in the dress, the carpenter was sent down , and in half-an-hour the leak was repaired. The water was pumped out, the ship got off the bank, and proceeded on her homeward voyage. On reaching home, it was admitted that the damage had been repaired as effectually as if it had been done in one of the naval dockyards. It struck him that engineers had paid less attention to the use of diving dresses and diving apparatus generally, in submarine works, than they deserved. He had endeavoured to interest them in the subject on other occasions by descriptions of those apparatus, but however pleased they might be at the moment, their attention had not been given to the subject. They still retained the ponderous diving-bell, with its costly stages, platforms, and piers, whereas a common ship's boat would serve the purpose with greater safety to the divers. The great—in fact the only—point with regard both to diving-bells and diving apparatus, was to keep up a constant supply of condensed air to the divers, and to have condensing air-pumps and pipes of the best quality. He ought to mention that his diving dresses had been employed in the Bay of Navarino, in recovering guns from the Turkish ships, at a depth of 500 feet, which had been effected without difficulty, and with perfect safety to the driver.

Mr. Lawrence remarked that diving bells were not usually made heavier than was required for sinking them in the water, but the chains must be of a strength sufficient to bear the whole weight of the bell when out of water. In a bell 9 feet by 4 feet by 6 feet, the displacement would be six or seven tons, and such bells would weigh about eight tons, therefore the chains must be able to lift that weight.

Mr. Newton remarked that he had gathered from the paper, that Major Sears proposed to move his machine, when submerged, by the divers pushing it from the outside. If that were the case it involved the use of the diving dress by the persons so employed, and if so he did not see the necessity for a diving bell of this description. For the purpose of moving heavy weights, he thought the caissons ordinarily used in constructing breakwaters, &c., answered every purpose. With regard to the observations of Sir Charles Fox, he (Mr. Newton) would say the case mentioned by him was not the first attempt to blow up enemies' ships. During the American war of Independence, a plan was proposed for blowing up the British ships, which did not suceeed.

The Chairman said that he had had a previous opportunity of inspecting the model upon the table, and he was much pleased with the obvious attention which had been paid to a number of practical details, which all mechanics knew were the desiderata in a work of this kind. All of them who in their younger days had read books upon mechanics, would remember that machines had been proposed for locomotion under water, and no doubt the idea itself was an old one; but, after all, the carrying out was dependent on the successful arrangement of minute details. He must say, with regard to the machine before the meeting, he was much pleased with the evidence of the careful consideration which must have been devoted to bring this machine to perfection. It did not seem calculated to supersede the diving dress. No doubt the facilities offered by those dresses, for moving under water were very great; but the peculiarity of this machine appeared to be the subaqueous motive power that it afforded; in other words, it enabled men to work under water, and move heavy bodies, which could only be lifted by cranes; and to place stones for foundations, with as much accuracy as could be done by a mason working on land. This struck him as one of the principal advantages of the machine. Although a great portion of the work could be performed by the men within the machine, yet there was nothing to prevent men wearing the diving-dresses assisting in the operation outside. He regarded the machine as an exceedingly useful invention. With regard to the observation of Mr. Bethell, that it was difficult to get engineers to pay attention to this subject, he might say that engineers were occupied largely with works above ground, whereas they had not frequent opportunities of building walls below the surface of the water. Submarine engineering operations were comparatively rare, and generally involved great expense. It was not from want of attention to the subject on the part of engineers, but rather from the fact that if they took all the submarine works during the last 10 or 15 years, and added them together, they would form a very insignificant item compared with the other descriptions of works which had occupied the attention of engineers during that period. At the same time, he would say, on behalf of the profession generally, that they were extremely glad to see any improvement in the machinery adapted for the purposes of construction under water.

Sir Charles Fox explained, with regard to Dr. Payerne's apparatus, that when at work they had no communication with the shore, because, when they had to work in heavy weather, it was necessary to get into still water before they could work, and with that machine they could bring away each time four cubic yards of blasted rock, or other material which had to be removed. He would conclude by observing that he entertained a high opinion of the merits of Major Sears' invention, which he thought calculated to answer well the purposes for which it was intended.

Major Sears, in reply to Sir John Rennie, said that he was fully aware of the improvements made by Sir John and his father in the ordinary diving-bell; he would beg, however, to correct him with regard to the similarity of the machine used, not in 1809-10, but, during the revolutionary war between England and the colonies, when the submerged boat, the same as that now used by Dr. Payerne, was adapted to blowing the enemy's fleet out of the water. [A description of the failure of the enterprise was here given by Major Sears.] In reference to cutting off piles, it was a question of economy whether the circular-saw or the arrangement with the Nautilus would be most economical. In answer to Sir Charles Fox, he would say that, although Sir Charles characterised the invention as nothing new, and as combining the same principles as Dr. Payerne's machine, yet, while admitting that "there is nothing new in engineering science," it was nevertheless true that new combinations produced new results, and that Dr. Payerne's principle involved serious disadvantages, inasmuch as, admitting that his boat might lift by the exhaustion of water, one or two stones, yet, when that power had been exerted, it was necessary to return to the surface to get a fresh supply of air. According to the report of Lieutenant Tyler, R.E., it took thirty minutes more to descend in forty feet of water than the ordinary bell, and assuming the latter to occupy ten minutes, the time required to ascend and descend would necessarily be not less than an hour, in which time the Nautilus would place three or four stones. In reply to Mr. Lawrence, Major Sears admitted that, like Spalding's bell there were two chambers, and perhaps, in some cases even more; yet, as Mr. Lawrence remarked, Spalding's bell had never been brought into use. Mr. Spalding certainly used suspensory chains. It was well known that in addition to the suspending chain there was a safety chain, but that chain was liable to become fouled

with the suspending chain, and when human life was at stake no precaution should be omitted. It might be possible for the divers to have a sufficient supply of air to enable them to wait for a reconnection, yet, they would of necessity be very uneasy, being dependent on the exertions of others; but, in the Nautilus, even supposing the hose to be broken, the divers had within the machine itself several distinct means of bringing it to the surface. In reply to Mr. Heinke, he would say, it was not intended to supersede submarine armour, but to make use of it as an adjunct. As to cost of apparatus, the extra cost would be more than compensated by the extra labour performed; inasmuch as the Nautilus could do more work than ten or more men in armour. In reply to Mr. Fraser, he would remark, that the dimensions or form not being arbitrary, the Nautilus could be adapted to perform the work required in a well with ninety feet of water; as it might be made from five to ten feet in diameter, and with a lifting power of from one to six tons. In reply to Mr. Bethell, he thought that, theoretically, india-rubber on an inflexible frame might answer, if the relative density could be maintained between the inside and outside; yet, as so many contingencies were apt to arise, it would not do to place trust in so frail a material. As to the weight of the ordinary bell not being necessary, it must be allowed that, when the volume of air had displaced a certain amount of water, it was necessary to compensate by weight for the weight of water displaced, and therefore he must insist that chains, capable of bearing six or seven tons, were required for an ordinary bell. As to the air-bag on the top of the diving-dress, or bell, it was but of little value, as the supply of air was necessarily limited. In answer to Mr. Newton, he would remark that that gentleman had evidently misunderstood his meaning; where there were no currents, the operator stepped through the lower trap of the Nautilus on to the bed of the sea, and, pushing with his hands against the *inside* of the machine, caused it to move. When, however, currents had sway, the cables were employed as described, either holding or moving it as might be required. Men with diving-dresses were not habitually employed inside, although they might be, in particular cases of exploration. Although caissons might be used in some localities, yet they were not applicable in all cases. The United States government had built a caisson at Pensacola, costing some fifteen thousand dollars, which subsequently cost twelve thousand dollars to remove from the channel, where it had overturned. Further, as Mr. Newton could not see the advantages, he would briefly sum them up, premising that any improvement in science or the arts was to be appreciated by its practical utility. The Nautilus possessed the power of commencing the actual work at once, whilst with the ordinary bell extensive preliminary operations were necessary; and it was but fair to suppose that, before such preparations were concluded, by the use of the Nautilus, the work would have considerably advanced. Then the facility of lifting and transporting weights certainly afforded the means of constructing a work in one-third the ordinary time; since, if the ordinary diving bell could do but four hundred cubic feet per day, the Nautilus could do three times as much with the same amount of labour. This he considered, quite a sufficient advantage, in addition to the time gained in the selection of foundations and their subsequent preparation. In a word he would say, that in all his statements he had asked them to take nothing upon trust, for he was prepared to verify every word that had been uttered, by reference to practical operations to be performed by a large machine, shortly to be placed in the Victoria Docks, where he hoped that all who were sceptical as to its merits would practically test its operations.

A vote of thanks was passed to Major Sears.

The Secretary announced that on Wednesday evening next, the 11th inst., a paper by Major H. B. Sears, "on Appliances for Facilitating Submarine Engineering and Exploration," would be read. Part II. Submarine Exploration.

SOULAGES COLLECTION.

The following correspondence has taken place in reference to this collection :—

To the Right Hon. Sir Benjamin Hall, Bart. M.P.

Sir,—We beg leave respectfully to call your attention to an importation recently made into this country, known as the "Soulages Collection," consisting of numerous interesting objects of an artistic and decorative character, illustrative of the tastes and manufactures of Italy in the fifteenth and sixteenth centuries, and extremely valuable as examples for study to artists engaged in the various departments of industry and manufactures to which art is applicable.

It is because we feel strongly the great importance of the formation of a museum or collection of such objects and examples of industrial art, and the immense advantages that would necessarily result in the progress of many branches of our munufactures from providing means and facilities for seeing and studying the artistic works produced in other countries and in former ages, that we venture to trespass on your attention, and request your assistance as the representative of a constituency which comprises a great number of persons engaged in occupations that would be greatly benefited thereby. The want of a collection of this nature has long been seriously felt in the metropolis, and the principle of the formation of such a museum has been recognised by the government, and acted upon by purchases made at the sale of the Bernal Collection, at the Great Exhibition of 1851, and the Universal Exhibition at Paris in 1855. It is a requirement which has been abundantly provided for in Paris by the collection at the Hôtel Cluny, some departments of the Louvre, and the examples and specimens at the Imperial manufactories of Sèvres, Gobelins, and Beauvais, which have exercised a powerful influence upon the education of numerous artists and art-workmen, and greatly contributed to the improvement and extension of many branches of manufacture.

The Soulages Collection would be a most valuable acquisition in the formation of such a museum as we have referred to, and government has now the opportunity of purchasing it upon terms so advantageous, that we consider it would be a neglect of duty not to secure it for the nation. It has been purchased by a number of noblemen, gentlemen, manufacturers, and others engaged in business, whose names are the best guarantee of its value in every sense, whether considered commercially or in an artistic point of view; and having incurred the risk of purchase and conveyance, they have, through the assistance of Lord Stanley of Alderley, the President of the Board of Trade, given many thousands the opportunity of seeing it at Marlborough-house, and now offer it to government for the public benefit at its prime cost of about £13,500, including carriage and all expenses attending its importation.

The most favourable opinions have been expressed regarding it by those most competent to judge of its merits as a collection. As a proof of this we may point to the Report of the Committee appointed to examine it by the Council of the Royal Institute of British Architects, who conclude a long and able notice by saying,—"And they have come to the conclusion, that it would be an irreparable loss of a great opportunity to improve our manufactures, to enlarge the sphere of art application, to increase our commerce, and instruct the public mind, if the government did not accept the offer to sell the whole

to the nation at cost price: an offer so nobly made by the disinterested and public-spirited men, who, with singular generosity, and on their own responsibility, have at all risks afforded the opportunity to the country of securing the collection in its entirety."

We need not add any observations of ours to the high authority from which we have borrowed the foregoing extract, but it is necessary that we should state most emphatically, that the gentlemen who have combined to purchase the collection have had in view the sole object of supplying a public want in a purely disinterested manner. No doubt whatever exists in the minds of those most competent to judge, that a much larger sum could be realised by public auction than the cost of this collection. To guard themselves against the slightest imputation of interested motives, it has been expressly agreed that, in the event of a sale by auction, the surplus exceeding the cost and expenses shall be devoted to the encouragement of art.

The study of objects such as are comprised in this collection is as necessary to the education of the art-workman as the study of ancient monuments and edifices is to the architect, the remains of Greek art to the sculptor, or the works of the old masters to the painter.

We therefore hope you will lend the influence of your sound judgment and cultivated taste, and your voice as the representative of a numerous and important constituency, to induce the government to become the purchasers of the Soulages Collection, and thus assist in rendering an important service to the public.

We have the honour to remain,
Sir Benjamin,
Yours most respectfully,

Signed............ PETER GRAHAM.
JOHN G. CRACE.
JOHN JACKSON.
EDWARD BOND.

February 18, 1857.

DEAR SIR BENJAMIN,—I have the honour to transmit herewith a letter signed by three of your constituents besides myself.

No other person has been asked to sign, and as the addresses of those who have signed are not added, I think it right to state that Mr. J. G. Crace resides in Wigmore-street, and has done the greater part of the decorative work in the interior of the Houses of Parliament; Mr. John Jackson is of the firm of George Jackson and Sons, Rathbone-place, and is the first man in his way of business in Great Britain; and Mr. Bond is the most active partner in the firm of Gillow and Co., Oxford-street.

Hoping that you will approve of the object we have in view, and lend your able assistance to accomplish it,

I remain, dear Sir Benjamin,
Yours faithfully,
P. GRAHAM.

To the Right Honourable
Sir Benjamin Hall, Bart., &c.

[To this Sir Benjamin Hall has replied, that he would forward the letter to Lord Granville as President of the Council.]

COMPETITIVE EXAMINATION.

(From the *Times*, March 2.)

With respect to the competitive system, the Commissioners make a favourable report of their experience, and, although they admit that the system is as yet in its infancy, they anticipate good results from an extension of its opportunities. For ourselves we regard this question as lying in so very small a compass, and being so transparently plain in character, that we are not disposed to waste arguments upon it. How, in short, is it possible that examiners deputed for the purpose, and employing the best known means without any extraneous bias, should not make a better selection of candidates than patrons open to bias, and employing, as must be presumed, no means at all? Even in the examinations which are not actually competitive there is a good element at work, both for the public service and for the general body of competitors. If out of 100 candidates nominated for appointments 60 or 70 only are pronounced qualified, the rejection of the others at once opens the field of nominations to 30 or 40 more, so that, while the several departments obtain better servants, well qualified candidates obtain a greater number of chances. In all respects, indeed, such a scheme ought to work for the advantage of the country, and not the least of the benefits resulting will be found, we trust, as the Commissioners themselves anticipate, in the general improvement of education which the application of this stimulus will promote.

DEATHS FROM SNAKEBITES IN INDIA.

(From the *Bombay Courier*.)

The number of deaths arising from snakebites in the various zillahs and towns subordinate to this presidency having been brought to the notice of Mr. A. Bettington, Commissioner of Police, by several magistrates, that gentleman addressed a letter to Government to the following effect:—

"I have the honour to report, for the information of government, that the loss of life from the bites of snakes in some districts of this presidency is considerable. In the Dharwar Zillah, for instance, no less than 16 deaths are reported to have occurred within the last four months from this cause. It appears that more deaths are occasioned by snakebites than by tigers. I beg to propose, for the consideration of government, that rewards be offered for the destruction of snakes—eight annas for a snake of any kind, and 12 annas for a cobra; to be paid on the production of the snake forthwith by the Patel and Kolkurnee of the village, who will forward the dead snake (by the village Mhar), with the receipt, to the nearest Mahulkurry or Mamlutudar. It is absolutely necessary that the payment should be prompt, and the reward sufficiently high to induce people to occupy themselves in killing snakes. I purpose to make no exception, because the carpet snake, 'foorsa,' the whip snake, and the cobra (the snakes most commonly met with), are all poisonous, and there can be no exercise of discrimination. In an exceptional case, it would not answer to withdraw payment while ignorant persons, unable to detect the poison-fang and gland, were debating whether the reptile was or was not poisonous. It will be necessary also that the magistrates shall continue to urge and compel the removal of masses of prickly pear from the villages. In many places it does not exist in the form of a boundary hedge, but in patches of greater or less extent, not only occupying ground that might be turned to other purposes, but harbouring reptiles and infecting the air."

In reply the government approved and sanctioned the suggestions of the Commissioner of Police. The people, encouraged by the rewards offered, are occupying themselves most actively in destroying these reptiles. Each day nearly 300 dead snakes are brought in. Mr. Bettington saw an immense number of every description; the most common of all is one called the "foorsa." The civil surgeon of Rutnagherry knows no remedy for the poison of this deadly reptile. Ammonia and other stimulants, if applied in time, are effective antidotes to the poison of the cobra and some other snakes, but are of no avail against the poison of the foorsa. The poison does not act on the nervous system, like that of the cobra, but on the blood alone, which becomes corrupted in a peculiar manner.

GALVANISM AND ITS ECONOMICAL APPLICATION IN THE ARTS.

A committee has been formed in France to examine and report on the merits of the competitors for the prize

of 50,000 francs (£2,000 sterling), offered by the decree of the 23rd Feb., 1852, for the discovery of a means of rendering the galvanic battery commercially applicable in the arts either as a source of heat or light, or as a mechanical power or as a chemical or medical agent. The committee consists of MM. Dumas, President; Chevreul, Pelouze, Regnault, Despretz, Rayer, Serres, Charles Dupin, Séquier, Poncelet, Morin, Members of the Academy; Reynaud, director of lighthouses; and Henry Sainte-Clair Deville, of the Normal School.

NAPOLEON I. AND FULTON.

Napoleon has frequently been reproached with having coldly received Fulton and his plan for the application of steam to the purposes of navigation. Marshal Marmont, in his memoirs, says that Buonaparte, who, from his education in the Artillery, had a natural prejudice against novelties, treated Fulton as a quack, and would not listen to him. M. Louis Figuier also, in pp. 258 *et seq.*, the 3rd vol. of his work, writes that Bonaparte refused to place the matter in the hands of the Academy. The following letter from Napoleon, dated from the Camp at Boulogne, 21st July, 1804, and addressed to M. de Champagny, Minister of the Interior, proves the contrary. It is given on the authority of "Cosmos:"—

"I have just read the project of citizen Fulton, an engineer, which you sent me much too late, for it seems capable of *changing the face of the world.* At all events, I desire that you will immediately place the examination of it in the hands of a Committee, composed of members of the Institute, for it is to them that the scientific men of Europe will naturally look for a decision on the question. A great physical truth stands revealed before my eyes. It will be for these gentlemen to see it, and endeavour to avail themselves of it. As soon as the report is made it will be sent to you, and you will forward it to me. Let the decision be given in a week, if possible, for I am impatient to hear it."

INDIAN FIBRES.

A public sale took place at the London Commercial Sale-rooms, Mincing-lane, on Friday, Feb. 6th, of 243 bales of East Indian Fibres, being samples imported by the Honourable East India Company for experiment.

The following is a list of the different kinds sold, and the prices fetched per ton.:—

Oodrah, from £4 10s. to £5 5s.; true Hemp, from the Himalayas. from £26 15s. to £32; Aloe, from £35 to £40 5s.; Putsun Hibiscus, £16; true China grass from Assam, Rhea fibres of various kinds, some partly prepared, from £30 15s. to £46; (Sunnd fibre, (*crotolaria juncea,*) £21 10; true Hemp of the Himalayas, partly prepared in England, from £29 to £30 5s.; tow, £11 5s.; Nettle fibre, £22; Nettle mesakee, £22; Hibiscus, £11 5s. to £25; Gharoo, £10 5s.; Tale Rameh, £40 5s.

Home Correspondence.

INTEROCEANIC RAILWAY.

Sir,—A great objection to any railroad, for connecting the Atlantic with the Pacific Ocean, is that vessels must be unloaded at either extremity, and reloaded again at the other end; but this might be obviated. Sir Samuel Bentham obtained that first-rate men-of-war should for small repairs be taken into dock with all in, and it is now commonly practised. This proves that the hull of a vessel is strong enough to bear the weight of its cargo. Ships of the line built at St. Petersburg, are, in cradles, borne over the shallows formed at the mouth of the Neva, hence it appears that a vessel can be supported in a cradle as in a dock. It seems needless to enter into such particulars as that a ship with its lading might for ordinary traffic rest on a double line of rails.

I am, &c.,
M. S. BENTHAM.

26, Wilton-place, Jan. 30th.

Proceedings of Institutions.

Boston.—The Rev. P. W. Clayden recently delivered a lecture in the Assembly Rooms to the members of the Athenæum, T. Garfit, Esq., in the chair. The subject was—"Habit. 'Use is second Nature.'" The attendance was excellent, the large room being well filled. After a long and interesting exordium the lecturer proceeded to the subject itself, first defining it, then showing its bearing on practical life; tracing the "genesis" of habit in the body, both in its active and passive form, and deducing the law or principle through the operation of which "use" creates "a second nature" in us. Passing on from habits of body, habits of mind came under consideration; and the lecturer showed how the great object of all education was the formation of "good habits of mind," strongly defending "classical" education, as producing a healthy, vigorous, liberal habit of mind. The influence of habit on the opinions, on the social feelings, on the sentiments, and on the passions, was then traced, and a striking contrast drawn between love as a passion of youth, and that love which owes its existence to habit. The lecturer then went on to show the beneficence of the law of habit in its operation, equalising as it did the inequalities of society, reconciling men to their external conditions, and compensating to a great degree the hardships of the world; concluding by a rapid summary of the practical principles the lecturer had developed. J. Noble, Esq., thanked the lecturer, in the name of the meeting, observing that such a lecture must have cost him no ordinary amount of thought and labour. Mr. Clayden, in thanking the audience for their attention, said that on this his first appearance on that platform he had been so well received, he should hope to make his appearance there again. Mr. Clayden has, we believe, intimated, in answer to an inquiry, that he is willing to deliver the lecture gratuitously to any of the other Institutions in the county.

Coupar Angus.—The twenty-second anniversary of the Nautical Improvement Society was held on the evening of Tuesday, the 24th ult., Mr. John Mills occupying the chair. The chairman, in a few introductory remarks, recommended that, instead of the time of the meeting being taken up in listening to set speeches, they should form themselves, for the time being, into a debating club. This suggestion was immediately acted upon, and a spirited discussion, on various subjects, was carried on. It is gratifying to observe a growing desire, on the part of the members of this Society, to extend its usefulness.

Deptford.—The annual meeting of the members of the Mechanics' Literary Institution was recently held, Mr. Crossland in the chair. The secretary, Mr. Alexander Dickson, read a statement of the finances of the Institution, and gave a report of the general progress of the Institution during the past year, which was most encouraging. At the last annual meeting a heavy debt hung over the Institution of upwards of £400; now, the total amount of debts owing scarcely exceeded £70, exclusive of the standing loan on debentures for £1,200, the interest of which was paid yearly.

Eastern Counties Railway and Stratford.—The committee, in presenting the fifth annual report of the proceedings of the Mechanics' Institute, have much pleasure in congratulating the members upon its continued prosperity and the success which has attended its proceedings. The number of members is—20 honorary

and 478 ordinary, being an increase of 208 as compared with last year. The circulation of books from the library has considerably increased, there having been nearly 5,000 registered issues during the year, and, during the past year upwards of 300 volumes have been added to it. The lectures and entertainments have been well attended, and have been received with considerable satisfaction, and so large has the attendance been in some instances as to cause the committee to confine the admission to members of the Institution, and to refuse that privilege to the public. The thanks of the members are due to the Directors of the Eastern Counties Railway Company for having kindly granted the use of a train for an excursion to Southend. About 2,100 persons availed themselves of the opportunity thus afforded them. The committee, after considerable discussion, determined upon recommending the reduction of the amount of subscription; and it affords them great satisfaction to state that this reduction has proved eminently successful—in nearly doubling the number of members, and thereby causing a large increase of subscriptions, whereby the committee were enabled to discharge all outstanding liabilities, and can now state that the Institution is entirely free from debt, and that, after the payment of nearly £100 for books, papers, and periodicals, they are enabled to show a balance in hand of upwards of £17. The plan of deducting the subscriptions from the pay sheets fortnightly has been found to work exceedingly well—nearly 300 paying their subscriptions by that mode. The following classes are in operation—Mechanical Drawing, Vocal and Instrumental Music, Writing, and Arithmetic. A French Class is in course of formation.

Greenwich.—The recently-published report of the Society for the Acquisition and Diffusion of Useful Knowledge, shows a manifest progress. There were 682 adult members, and 48 minors, at the close of last quarter, and 200 new members have been elected since the commencement of last year. There has also been more activity in the classes during the past six months than at any previous period. The number of books taken from the library is regularly increasing. During the month of August, 1,878 volumes were read, and during the month of November the number reached 2,475 volumes. The committee present a statement of the income and expenditure for the past six months. The receipts—including members' subscription, sale of catalogues and newspapers, library fines, &c., have been £277 12s. 10d.; and the expenditure for newspapers, books, lectures, printing, salaries, &c., £262 12s. 3d., leaving a balance in the treasurer's hands of £15 0s. 7d.

Hackney.—The ninth annual report of the Hackney Literary and Scientific Institution shows that it is in a flourishing state. From the balance-sheet attached to this report, it will be found that the receipts from all sources during the year have been £374 12s., and the expenditure £273 16s. 11d., and that there is a balance in hand of £19 0s. 8d. The number of members was—at Midsummer, members, 430; ladies' transferable tickets, 124;—at Christmas, members, 411; ladies' transferable tickets, 137. The committee have only been able to expend a sum of about £30 on the library. This they look upon as one of the most popular features of the Institution, and they would have been much gratified to have added more materially to it. The circulation of books during the past year has been on an average 225 per week. The reading-room has been well supplied during the year with papers, and the attendance has been on the whole satisfactory. During the past year the committee provided for the delivery of twenty lectures, and two vocal and instrumental concerts, as follows:—The opening concert in January, conducted by the Distins, and that in September, by Miss Ada Thomson. Sergeant Pearce, on the Crimean Expedition. Mr. Edney, two Musical Entertainments. Mr. Wyld, on John Howard. Dr. Letheby, on the Sweets we Extract. Mr. Parsons (two), one on Thomas Hood and one on the Wits of Queen Anne's Reign. Mr. Salaman (two), one on the History of the Pianoforte and one on Music in connection with the Dance. Mr. Crispe, on the Philosophy of Humbug. Mr. Charles, on the Ludicrous and Lyrical Literature of Love. Mr. G. Dawson (two), one on Peter the Great and one on Martin Luther—his Private Life and Character. Mr. W. Dawson, on the Style and Characteristics of English Glee Writing. Mr. Serle, a Dramatic Reading—the "Merry Wives of Windsor." Mr. Cooper, a Musical Entertainment, entitled, "Sketches of a Tour from Burton-crescent to Balaclava. Dr. Pettigrew on the Arch of Life. Dr. Noad, on the New Induction Apparatus. Mr. Blackburn, on Algeria—its History and Customs. Mr. Fairbairn, a Scottish Musical Entertainment, entitled, "Wanderin' Willie's Wallet."—In addion to these, the following were delivered gratuitously:—Rev. D. Katterns, on Curiosities of Biblical Interpretation and Eccentricities of Preachers. Mr. G. Offor, jun., on the Genius and Writings of Albert Smith. Mr. Wortabet, on Syria and the Holy Land. Mr. Thomas Price, on Sir Thomas More—his Life and Writings. Mr. Grant, on Lord Byron—his Times, Life, and Writings.—The classes have continued their meetings.

Halstead.—The annual meeting of the Literary and Mechanics' Institution was held on the 29th of last December, and a *soirée* in connection with the Institute came off on Tuesday the 3rd of February. About 30 ladies presided over the tea service, and several members offered explanations of diagrams representing locomotion and Australia and Australian life, procured from the Working Man's Educational Union. Some members assisted with the dissolving views, the lantern being kindly supplied by E. Courtauld, Esq., while Sidney Courtauld, Esq., his son, was superintendant. Some photographs from the Society of Arts were exhibited, and much admired. Some members performed vocal and instrumental music. E. W. Harris, Esq., the newly elected president, occupied the chair. The report of the Committee shows that the prosperity of the Institute during the past year is in advance of any that has preceded it. The number of the present members exceeds that of any former period, and the income of the Society, from nearly all sources, has reached a higher point. During the last year, the members have increased to 235, being an increase of 35 over any preceding year, and of 56 over the last year. The receipts and expenditure for the year show a balance in favour of the Institute of £16 13s. 1d., which reduces the debt at the close of last year of £25 0s. 10d. to £8 7s. 9d. While in the year 1851 the total exchange of books and periodicals amounted to only 4,296, and in the year 1855 only reached 6,816, in the past year it has attained an aggregate of 9,698.

Liverpool.—At the annual general meeting of the members of the Liverpool Institute and School of Art, Mount-street, Mr. Thos. Thornely, M.P., the President, occupied the chair, and amongst other gentlemen present were Mr. George Holt, Mr. O. Williams, the Rev. Professor Griffiths, the Rev James Cranbrook, Mr. H. Shimmin, Mr. Haylock, Mr. Murphy, Mr. C. S. Samuell, Mr. Dickson, and Mr. Scott. The secretary read the report, which shows that the Institution has been eminently successful in all its departments. At the close of the year, 2,444 persons were connected with the Institute, as follows, viz.:—Life members, 600; annual members, 161; subscribers to the library and reading-room, 166; lady subscribers, 13; pupils in the day-schools, 838; ditto, evening-schools, 529; ditto ladies' drawing-classes, 33; ditto, ladies' college, 104. The receipts between March 1 and December 31 amounted to £2,797 9s. 11d. The attendance in the evening-school has increased yearly since 1853, and last quarter it was greater than it has ever been since 1849, the number on the respective class-rolls being as follows:—English classes, 94; writing,

154; arithmetic, 163; mathematics, 18; drawing, 141; adult, 60; French, 41; German, 10; Spanish, 10; Latin, 5; dancing, 19—total, 715. Arrangements are in progress, under a committee, composed of members of the Town Council and of the managers of this and the Collegiate Institution, for exhibiting a collection of choice specimens of ornamental work purchased by Government on the breaking up of the Great Exhibition of 1851, the loan of which has been granted for this purpose by the Department of Science and Art. The exhibition will be held in March. The considerable additions that have lately been made to the library have led to so large an accession of subscribers as to satisfy the directors that a liberal expenditure on it will be attended with a corresponding increase of income, in addition to its extending the usefulness of the Institute. The chairman proposed the adoption of the report. He considered that the Institution was so firmly established in public opinion that it was necessary only to keep it in working order to continue to do that great good which had been its result from the beginning up to the present time. Mr. George Holt, in seconding the resolution, said that there never was a period since the establishment of the Institution, in 1825, when its supporters had more reason to be quite satisfied than at present. One thing particularly had always given him great satisfaction, and that was, that they had given a perfect example, upon a large scale, of the successful education of 1,000 or 1,500 young people of both sexes upon non-sectarian principles. The meeting was then addressed by Mr. Samuell, Mr. Murphy, Mr. Haylock, Mr. O. Williams, the Rev. Professor Griffiths, Mr, M'Ilveen, Mr. Dickson, and Mr. Shimmin. After passing the usual votes of thanks, the meeting separated.

Lockwood.—The first Annual Soirée of the Mechanics Institution, was recently held. The following were among the gentlemen present:—The Rev. T. B. Bensted, Rev. J. Haigh, (St. Pauls); Rev. J. Hughes, of Meltham; Rev. J. Barker, Baptist minister, Lockwood; Rev. J. P. Chown, Bradford; Wm. Crowther, Esq., Gomersall; J. C. Fenton, Esq., Wm. Barker, Esq., T. C. Wrigley, Esq., John Shaw, Esq., James Whitley, Esq. Messrs. W. Crosland, Josiah Berry, W. Wilson, James Shaw, Thomas Haigh, Edgar Fenton, Charles Crosland, Joseph Wrigley, jun., Patrick Martin, W. Taylor, W. Kaye, James Crosland, James Brierley, &c. Bentley Shaw, Esq., the president of the Institution occupied the chair. The Secretary read the report, which stated, that the Lockwood Mechanics' Institution was established in March, 1844, by a few working men, who felt the necessity of self-improvement. But it was not until the year 1855, that the committee, with the assistance of a few gentlemen of the neighbourhood, determined to take the steps which have placed the institution in its present position. Since the removal to the new premises the number of members has more than doubled; and the accommodation is now such that 200 students can be seated comfortably. The committee, aware that the prosperity of the Institution depends chiefly upon the character of the classes and the nature of the class instruction, have paid much attention to this important subject. There are six class-rooms, five of them occupied on Monday evenings, five on Wednesday, and four on Friday, besides two on Saturday; making a total of 16 classes per week. The subjects actually taught are reading, writing, arithmetic, algebra, mensuration, history, geography, grammar, music, free-hand and ornamental drawing. The first and most important classes are the adult. These are attended by young men of from 18 to 35 years of age, who work with much steadiness and determination. The junior classes, too, are well attended, and generally speaking, in a satisfactory state. Number of members for December, 1856—Annual members, 17; weekly, 164; quarterly, 10; presentees, 10; honorary, 11; total males, 212. Females—Weekly, 42; presentees, 3; total females, 45; total males and females, 257. The number of female members at present is 50. The average attendance per night for the last month—three nights a-week—is, males 91, besides 50 at the singing classes. The average attendance per night of females—two nights a week—is 41. The gross attendances for five weeks ending November 29th, is 2,043. There are five paid teachers in the Institution, and an efficient staff of eight volunteers. The library contains 425 vols. The issue for the past year is 2,903. The meeting was then addressed by the President, by the Rev. Joseph Hughes, the Rev. J. Barker, W. Crowther, Esq., the Rev. T. B. Bensted, the Rev. E. Boden, T. P. Crosland, Esq., the Rev. T. P. Chown, J. C. Fenton, Esq., Joseph Wrigley, Esq., and W. C. Kaye.

Salford.—The adjourned examination of the pupils of the boys' day-school in connection with the Mechanics' Institution, was recently held. The subject of the examination was, "The Chemistry of the Air and the Physiology of Respiration." Mr. David Chadwick was elected to the chair, in the absence of Mr. Alderman Agnew, who was unable to attend. Mr. Angell, the teacher, in a few prefatory remarks, defined the objects of education to be:—To teach how to think—to develop the power to think—to discipline the mind into the practice of right-thinking—and to communicate generally useful knowledge. The children proved, in reply to the questions and experiments of the teacher, the existence, properties, and composition of the atmosphere, and the nature of combustion and chemical combination. In physiology, they explained the structure and functions of the chest and the organs contained in it—the nature and uses of the blood, and the changes produced in it by respiration, Mr. Plant proposed, and Mr. A. Somers seconded, a vote of thanks to Mr. Angell, which was carried. Mr. Angell, in acknowledging it, took the opportunity of alluding to the objection sometimes raised, that the teaching of the natural sciences must retard the progress of the pupils in grammar, arithmetic, &c., and stated that it produced exactly the opposite result.—The meeting terminated at ten o'clock. During the evening several airs were played on the pianoforte, by Miss Lawton.

Sidmouth.—An interesting and graphic lecture was delivered at the Institution on Tuesday, Feb. 3, by Charles G. Floyd, Esq., on the subject of "Dr. Johnson." The lecturer commenced by stating that it was not Johnson the philosopher—Johnson the essayist—Johnson the lexicographer—Johnson the LL.D. of two Universities—Johnson the poet—or Johnson the poet's biographer—but Johnson the man, that he proposed to described to them. And after briefly touching upon his true greatness, (despite many external drawbacks,) in this character, he proceeded to illustrate both, by the leading features of his life. The lecturer made some amusing remarks on the shifts and hardships of men of letters of the period, and then passed on to describe the dawning of brighter days; the publication of his famous dictionary, (with some very characteristic definitions contained therein); the celebrated letter to Lord Chesterfield; the pleasant story of his pension from the king; and his first acquaintance with his inseparable companion, James Boswell, best of biographers, vainest and silliest of men! After a tribute to that immortal club over which Johnson presided, and its mighty spirits, Burke, Goldsmith, Gibbon, Garrick, Reynolds, Beauclerc, and others, Mr. Floyd proceeded to illustrate the true grandeur of the man above all the details of littleness that disfigured him. After a series of anecdotes, illustrative of points in his character, and a final tribute to his real greatness, Mr. Floyd concluded his interesting lecture.

Welchpool.—The Committee of the Reading Society, in presenting their report, call attention to important changes that have been effected during the past year. The house originally occupied by the Society was attended with many inconveniences, and it was determined to remove to commodious premises in a central situation,

and to engage the services of a paid librarian, who should be regularly in attendance from 7 to 10 every evening. The expenses of removal, and the great additions made to the library during the past year, have occasioned a larger outlay of money than under ordinary circumstances might have been considered prudent; but the present arrangements must so tend to the comfort and convenience of persons frequenting the rooms, that the Committee rely upon a continued increase in the number of subscribers to maintain the Institution in its present state of efficiency, and to justify the purchase of more new books at no very distant period. The library now numbers upwards of a thousand volumes, and the rooms are supplied with three daily and six weekly newspapers, together with most of the popular reviews and serials. The attendance, especially in the evening, and the books taken out, amounting to 881 in the past year, are sufficient proofs that the Institution is appreciated by many in this town, and it is hoped that they will use their influence to induce a still larger number to share in its advantages. In conclusion, the Committee desire to acknowledge the valuable services of their Honorary Secretary, and to convey to him their hearty thanks. The Committee have to acknowledge the receipt of £12 2s. 6d. from the committee of Colonel the Rt. Hon. P. E. Herbert's reception fund for the purchase of books.

Wirksworth.—The report of the committee of the Mechanics' Institution, presented to the General Meeting of the members, Mr. Cantrell, President of the Institution in the chair, shows that the past year has been one of great prosperity, a large increase of members having taken place. The most pleasing feature of the past year was the festival, which will be remembered in Wirksworth and the neighbourhood for many years to come. One of the chief duties of the committee has been the formation of classes for the instruction of the younger members, and they have secured the services of Mr. Henry Marsden, to superintend the classes, which are now established. A number of books and maps have been purchased through the Committee of Council on Education, who have arranged for supplying the books and papers published by them, or their authority, to the Institutions in Union with the Society of Arts. The committee urge the members to qualify themselves by earnest study to become competitors at the Society of Arts Examinations, that their success may honour the Institution to which they belong. The total number of members is 136. The number of books lent during the year is 979. The following gentlemen are the officers for 1857:—*President*—W. Cantrell, Esq.; *Vice-President*—W. Webb, Esq., M.D.; *Trustees*—T. Poyser, Esq., J. Wheatcroft, Esq., W. Weight, Esq., and Mr. Peal; *Treasurer*—Mr. B. Street; *Honorary Secretary*—Mr. G. Marsden; *Librarian*—Mr. J. W. Hall; *Auditors*—Mr. Fryer, Mr. Peal, Mr. J. Hall; *Committee*—Messrs. W. Wright, T. Newton, Jun., Fryer, Surtees, Peal, W. Hall, Savage, Carrington.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered on the 26th February, 1857.

35 (1). Bank of England—Supplementary Return.
52. Duchy of Lancaster—Account.
59. Barracks, &c.—Return.
64. Committee of Selection—1st Report.
Agricultural Produce in Ireland—Return.

Delivered on the 27th of February, 1857.

62. Banks of Issue, &c.—Returns.
67. Extra-parochial Places—Copy of Correspondence.
19. Bills—Petty Sessions (Ireland).
20. ——— Turnpike Trusts Abolition (Ireland).
28. ——— Carlisle Canonries.

Delivered on the 28th February and 2nd March, 1857.

48. Flogging (Navy)—Return.
63. Persia (Expenses of Expedition)—Correspondence.
19 (3). Harbour, &c., Bills (3, Weaver Navigation)—Report of the Board of Trade.
68. Committee of Selection—2nd Report.
30. Bills—Commissioners of Supply (Scotland).
26. ——— Grand Juries (Ireland).
Inclosure Commission—12th Annual Report.
Copyholds—15th Report of Commissioners.
Tithe Commission—Report.

Session 1856.

436. Orders of Removal—Return.

Delivered on the 3rd March, 1857.

45. Local Acts (7 and 8, Watchet Harbour and Watchet Harbour Trust; 9, Tilbury, Maldon, and Colchester Railway; 10, Newry, Warrenpoint, and Rostrevor Railway; 11, Midland Great Western Railway of Ireland—Sligo Extension; 12, North Level Drainage; 13, Sunken Vessels Recovery Company)—Admiralty Reports.

MEETINGS FOR THE ENSUING WEEK.

Mon. London Inst., 7. Rev. H. Christmas, "On the History and Antiquities of Heraldry; and on some other branches of British Archæology."
Architects, 8. Mr. A. Ashpitel, "On the different theories respecting the Forum at Rome, particularly those of our late Member, the Commendatore Canina."
Geographical, 8½. I. Dr. James Campbell, "Remarks on the Geography and Hydrography of South-west Africa." II. "Notes on the Outlet of the Great Zambesi," from the Journal of the late Capt. Hyde Parker, R.N. III. Mr. Consul Abbott, "Journey in Persia from Shiraz to Darab, and thence westward to Hazeran."

Tues. Royal Inst., 3. Prof. Huxley, "On Physiology—Locomotion."
Syro-Egyptian, 7½. Mr. Samuel Sharpe, "On the Identification of the Egyptian and Persian Kings' names mentioned in the Bible, with those in the Hieroglyphics and Greek Historians."
Civil Engineers, 8. Mr. R. Armstrong, "On High-speed Steam Navigation, and on the Relative Efficiency of the Screw Propeller and Paddle Wheels."
Med. and Chirurg., 8½.
Zoological, 9.

Wed. Literary Fund, 2. Anniversary.
London Inst., 3. Mr. E. W. Brayley, "On Mineralogy and Crystallography."
Society of Arts, 8. Major H. B. Sears, "On appliances for facilitating Submarine Engineering and Exploration." Part II. Submarine Exploration.
Geological, 8. I. Dr. H. Falconer, "On the Species of Mastodon and Elephant occurring in the fossil state in England." II Mr. Bollaert, "On the occurrence of some Mastodon Bones in Chili."
Graphic, 8.
Ethnological, 8½.
Archæological Association, 8½.

Thurs. Royal Inst., 3. Prof. Tyndall, "On Sound."
Royal Society Club, 6.
London Inst., 7. Rev. C. Boutell, "On the Church of the Holy Sepulchre."
Antiquaries, 8.
Royal, 8½.

Fri. Astronomical, 8.
Royal Inst., 8½. Prof. Phillips, "Geological Sketches round the Malvern Hills."

Sat. London Institution, 3. Mr. T. A. Malone, "On Experimental Physics, chiefly in Relation to Chemistry."
Royal Institution, 3. Prof. Phillips, "On the Limits of Variation in the State of the Globe—Climate."
Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, February 27th,* 1857.]

Dated 26th December, 1856.

3064. Armand Jean Baptiste Louis de Marcescheau, Paris—Improvements in the modes of communicating or transmitting motion to propelling apparatus, engines, or machinery.

Dated 20th January, 1857.

160. Frederick Walton, Haughton Dale Mills, Manchester—An improved plastic composition, and in the application of machinery for manufacturing the same.

Dated 11th February, 1857.

397. John Talbot Pitman, 67, Gracechurch-street—Improvements in the mode of making metallic hames for horses. (A communication.)
398. John Talbot Pitman, 67, Gracechurch-street—An improved system of working metallic ores and their products, both metallic and mineral. (A communication.)
400. William Todd and Jacob Todd, Heywood, Lancashire—Certain improvements in power looms for weaving.
401. William George Armstrong, Newcastle-upon-Tyne—Improvements in ordnance.
402. Richard Dugdale Kay, Accrington—An improved method of using or applying a certain colouring matter, either singly or in combination with other colouring matters, to woven or felted fabrics, yarns, or threads, either in the white or dyed state. (A communication.)
403. John Poole, 2, Riley-street, Chelsea—Improvements in safety or other valves, and in mechanical appliances thereto.

404. John Macintosh, Euston-square—Improvements in the manufacture and discharge of projectiles.
405. James Saul Hendy, Essex-street, Strand—Improvements in chimney tops or cowls.
406. George Chappellpotts, New Oxford-street—Improvements in cleansing casks.

Dated 12th February, 1857.

407. Joshua Horton, jun., Brierley-hill, Staffordshire—New or improved machinery for regulating the generation and pressure of steam in steam boilers, and for preventing the explosion of steam boilers.
408. John Langford and Joseph Wilder, Birmingham—A new or improved signal and alarum.
410. Peter Hubert Desvignes, Lewisham—Improvements in machinery for preparing flax, hemp, and other fibrous materials.
411. David Baker, Gisbro' Alum Works, Yorkshire—Improvements in the manufacture of compounds of alumina and of magnesia.
413. William Wilkins, Camberwell—Improvements in flushing apparatus.
414. Isaac Blackburn, Islington, and Robert Blackburn, Edinburgh—Improvements in engines or implements to be employed in agriculture, applicable also to the transporting of heavy bodies to the traction of carriages, and to the conveyance of passengers.
415. Edward Maynard, Brooklyn, Kings, New York—An improvement in calks for the shoes of animals.
416. William Edward Newton, 66, Chancery-lane—Improved machinery for turning articles of irregular forms in the direction of their length. (A communication.)
418. Elias Bowcock, Manchester—Certain improvements in the manufacture of cords to be used in skirts and petticoats.
419. George Gimson, Staley-bridge—Certain improvements in steam engines.
420. Thomas Wingate, Glasgow—Improvements in screw propellers and in adjusting the same.

Dated 13th February, 1857.

421. Charles Wye Williams, Liverpool—Improvements in increasing the draught and promoting the combustion of the fuel in furnaces.
423. William Harry Harrison, Ty Mawr, Ponty Pridd, Glamorganshire—Certain improvements in the machinery or apparatus as at present employed for raising water from mines.
424. William Richardson, 5, Ranelagh-grove, Pimlico—Improvements in the use of iron or any other metal by itself, or in combination with other materials for structural purposes,
425. Frederic Henry Sykes, Cork-street, Piccadilly—An improved apparatus for supplying or feeding boilers with water, applicable to raising and forcing liquids for other purposes.
426. D. A. Lamb, Berwick-upon-Tweed—Improvements in water-closets, and in apparatus connected therewith.
427. William Stettinius Clark, High Holborn—Improvements in machines for grating substances. (A communication.)
428. Walter Sandell Mappin, Birmingham—A new or improved method of constructing doors and windows, for the prevention of burglary, which method of construction is also applicable to other articles where strength is required.
429. Noel Clayton Smith, Churton-street, Pimlico—Improvements in the disc engine.
430. Marmaduke William Hallett, St. George's-road, Eccleston-square—Improvements in apparatus for securing window and other openings in buildings.
431. John Lawson and Stephen Cotton, Leeds—Improvements in machinery for roving, spinning, or twisting flax, cotton, wool, and other fibrous substances.
433. Richard Houchin, junr., Bridport-place, New North-road, Hoxton—Improvements in alarums.
434. Titus Robottom, Atherstone, Warwick—Improvements in locomotive engines chiefly adapted for the purposes of common road or street traction, and the working of agricultural implements.
435. James Cocker, Liverpool—Improvements in, and apparatus for, the manufacture of wire, part of which improvements is applicable to the annealing of other metallic articles.
436. John Williams, Port Madoc, Carnarvon, N.W.—Improvements in apparatus for lowering and stopping anchor chains on board ships, and for other similar purposes.

Dated 14th February, 1857.

437. Andrew Barclay Walker, Liverpool—An improved apparatus for heating fluids.
438. Hamilton Henry Fulton, and Thomas Bodley Etty, 8, Great Queen-street, Westminster—Improvements in the generation and application of steam power for propelling, hauling, driving, or conveying, particularly applicable to farming purposes.
439. Alexander Forrest, Birmingham—Improvements in the construction and ornamentation of belt or band fastenings, and other dress fastenings.
440. John Cruikshank, Princes-end, Tipton, Staffordshire—An improvement or improvements in rolling iron and steel wire.
441. Joseph Firth, Flush Mills, Heckmondwike, Yorkshire, and Joseph Crabtree, Mill-bridge—Improvements in power looms for weaving fancy goods.
442. Archibald Smith, Princes-street—Improvements in machinery for the manufacture of wire rope and other ropes.
443. James Taylor, Upper-street, Islington—Improvements in the preparation or manufacture of manures.
444. Charles Robert Moate, 65, Old Broad-street—Improvements in the permanent way of railways.
445. William Cooke, Cornhill—Improvements in apparatus for ventilating.

Dated 16th February, 1857.

447. William Robinson Jackson, Baltimore, U.S.—An improved railway break.
449. John Crawley, Wood-street, Cheapside—Improvements in collars and wristbands.
451. William Edward Wiley, 34, Great Hampton-street, Birmingham—Improvements in the manufacture of metal pens and penholders.
455. William Clark, 53, Chancery-lane—Improvements in the manufacture of railway chairs. (A communication.)

Dated 17th February, 1857.

457. Henry Green, Liverpool—An improved stove to be heated by gas.
459. John Goodman, 29a, Pall-mall—Improvements in apparatus for holding together letters, music, and other loose sheets. (A communication.)
461. John Bennett, Birmingham—A new or improved joint for fishing rods, the rods or handles of parasols, and for other rods.
463. Emile Alcan, Fore-street—Improvements in machinery for twisting, doubling, and spinning cotton, silk, and other fibrous materials. (A communication.)
465. Jean Baptiste Pascal, Lyons—An improved engine with rotary piston applicable to various purposes.
467. Frederick Burnett Houghton, Upper Gloucester-place, Dorset-square—Improvements in the preparation of materials used in the manufacture of paper.
469. William Young, Queen-street—Improvements in fire-places or stoves.

WEEKLY LIST OF PATENTS SEALED.

February 27th.

1997. Thomas Lees.
2023. John Gregory.
2029. Richard Hill Norris, M.D.
2039. George Cumming Thomas.
2041. Jean Baptiste Marcelin Jobard.
2044. Louis Cornides.
2053. Joel Tanner Hart.
2064. John Benjamin Dancer.
2083. Peter Armand le Comte de Fontainemoreau.
2093. Francis Mitchell Herring.
2100. William Gossage.
2142. Edward Green.
2166. Rd. Archibald Brooman.
2177. William Frederick Spittle.
2225. John George Taylor.
2328. Alfred Vincent Newton.
2343. James Hinks.
2350. William Ward.
2422. John Green.
2476. William Ed. Newton.
2797. John Marshall, junr.
2941. George Collier.
2977. Edwin Heywood.
3056. Jules H. Etienne Mareschal.
3103. Charles Wye Williams.
46. Thomas Holmes.

March 3rd.

2054. Evan Leigh and George Peter Leigh.
2059. John Montagu Hayes.
2061. John Loude Tabberner.
2066. John Johnson.
2072. John Johnston.
2088. Adolphe Gilbert Chalus.
2092. Boniface Sabatier.
2095. William Petrie.
2106. Henry Cooke.
2122. John Gedge.
2126. John Milnes and William Thompson.
2147. Frederic Ducimetière-Monod.
2159. Stanislas Chodzko.
2253. Samuel Calley.
2258. William Horsfall.
2555. Louis Urion.
2590. William Edward Newton.
2594. Louis Urion.
2785. Charles John Lewsey.
2798. Alfred Vincent Newton.

Patents on which the Third Year's Stamp Duty has been Paid.

February 24th.

464. Charles Lamport
555. William Septimus Losh.
585. George Appolt and Charles Appolt.
696. William Wood.

February 26th.

522. Caleb Bloomer.

February 27th.

477. Leontide Agalaee Pallegoix and Alexandre Louis Bellangé.

February 28th.

524. William Vaughan and John Scattergood.
526. Charles Nightingale.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3950	Feb. 26.	Improved Gas Shade and Regulator	Thomas Patstone	Birmingham.
3951	" "	High Pressure Ball-cock	Robert Luke Howard	85, Whitecross-street.
3952	" 27.	A Clasp	Joseph Underwood	Birmingham.
3953	" 28.	White's Detached Watch Escapement	Hill, Son, and White	Coventry.
3954	March 3.	Improved double-bound Carpenter's Brace, with octagon compound lever pad	Robert Maples	Sheffield.